

**First year of Geomatics Department
Engineering Geology 2018
Lecture 3**

**MINERALS
(CRASHED STONES – SAND)**



Dr. Eng. Hassan Mohamed

CRUSHED STONE

Crushed stone or **angular rock** is a form of construction aggregate, typically produced by mining a suitable rock deposit and breaking the removed rock down to the desired size using crushers. It is distinct from gravel which is produced by natural processes of weathering and erosion, and typically has a more rounded shape.



USES OF CRUSHED STONE

Angular crushed stone is the key material for macadam road construction which depends on the interlocking of the individual stones' angular faces for its strength.^[1] Crushed natural stone is also used similarly without a binder for riprap, railroad track ballast, and filter stone. It may be used with a binder in a composite material such as concrete, tarmac, or asphalt concrete.



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MATERIALS FOR CRUSHED STONE

Many different types of rock can be used to make crushed stone. Almost any type of hard rock is a candidate to make this stone. The following types of rock are the most commonly used:

1. Limestone
2. Traprock
3. Washed gravel
4. Granite
5. Argillite
6. Quartzite



TYPES OF CRUSHED STONE

Crushed and Screened – The most basic form of crushed aggregate is crushed and screened stone. As the name suggests, the aggregate is manufactured as stone, is pulverized and crushed down to a specific size. The stone is not further treated and may include dust.

Washed Clean – This type of crushed stone is similar to crushed and screened stone, but in addition to being carefully crushed and screened to size, the material is also washed clean in order to remove any dust or debris.

TYPES OF CRUSHED STONE

Gravel – Gravel is a relatively small form of aggregate that can be used for both functional and decorative purposes. Some of the most popular types of gravel in NJ and its surrounding areas include pea gravel and round, yellow “Jersey Shore” gravel. Gravel is the perfect size for an array of different landscaping and construction projects.

Quarry Process – Sometimes referred to as Dense Grade Aggregate or Crusher Run, Quarry Process (QP) is comprised of both crushed stone aggregate and stone dust.

Riprap Stone – Riprap stone is the largest variety of crushed stone. Riprap may be as large as 9” in size.

Stone Grits – Stone grits are the smallest form of crushed stone. Grits are formed of very fine particles made from pulverized stone.

CRUSHED STONE SIZES



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CRUSHED STONE SIZES

< 0.635 cm – Crushed rock materials (stone dust and stone grits) are typically most useful for improving traction, for working as a binding agent, or for significantly reducing void spaces between other stone aggregates.

0.635-0.953 cm crushed rocks are perfectly suited for many different applications. At this size, the stones are comfortable enough for pedestrians to walk upon, and the stones are also safe to drive upon. This is also a great size for installing a French drain or other similar drainage systems. Many people also enjoy using this type of stone and gravel to replace traditional organic mulch, as it works well to regulate soil temperatures and moisture levels without decaying or attracting pests.

CRUSHED STONE SIZES

1.905 cm– Depending on the stone type, crushed rock at 1.905 cm in size could be used for several different functions. This type of aggregate is often selected for a variety of construction purposes, but it is also considered to be highly decorative. Whether it's accentuating water features, drawing attention to vegetation, serving as an edging material or replacing a traditional grassy lawn.

2.54 cm to 6.35 cm– Larger crushed stone in size is frequently used for a variety of different construction applications. It may be required in the production of Portland cement, as a filler material, to control the spread of mud or even as railroad ballast.

> 6.35 cm – In order to be effective, stones that control erosion like riprap must be larger and heavier in size than other aggregate materials. Crushed stone at this size may also be used for decorative purposes.

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CRUSHED STONE SIZES

Crushed stone #5 – Sizes are from 2.54cm down to fine particles. For road and paver base.

Crushed stone #67 – Sizes from 1.905cm down to fine particles. For fill, road and slab base.

Crushed stone #1 – Sizes are from 5.08 to 10.16 cm. The largest of the crushed stone grades. For larger jobs such as culvert ballast.

Crushed stone #8 – Sizes from 0.953 cm to 1.27 cm. For concrete and asphalt mix.

Crushed stone #3 -Sizes from 1.27 to 5.08 cm. For drainage and railroad projects.

Crushed stone #10 (also called stone dust) – Screenings or dust. For fabrication of concrete blocks and pavers and for riding arenas.

Crushed stone #57 – Sizes of about 1.905 cm. For concrete and asphalt mix, driveways, landscaping and French drains.

Crushed stone #411 – A mixture of stone dust and #57 stone. For driveways, roads and as a base for retaining walls. It can also be used to patch holes in paved areas. The dust mixes with the larger stone and settles well.

SAND

Sand is loose particles of hard broken rock, it comprises of grains from disintegrated rock. The diameter of grains ranges between 0.06 and 2.0 mm in size and varies in shades of brown and orange in color. Sand provides bulk, strength, and other properties to construction materials like asphalt and concrete.

It is also used as a decorative material in landscaping. Specific types of sand are used in the manufacture of glass and as a molding material for metal casting. Other sand is used as an abrasive in sandblasting and to make sandpaper.

Sand is an significantly important material for the construction but this important material must be purchased with all care and vigilance.

TYPES OF SAND

Sand can be classified based on various criteria. Such as general criteria and engineering criteria.

From engineering point of view, sand can be classified based on various thing. We will discuss them one by one below.

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PIT SAND (COARSE SAND)

Source: Pit sand is collected from the ground by digging a pit. The pit's depth is about 1m – 2m from ground level.

Grain: Pit sand consists of sharp, angular and rough grains. It is free from salt and organic materials. Because of the absence of salt in this sand it doesn't absorb moisture from atmosphere.

Sand Type: Pit sand is a coarse type sand.

Color: Due to coating of a iron-oxide it shows red-orange color.

Uses: Due to its superior binding quality it is widely used in civil construction.



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RIVER SAND

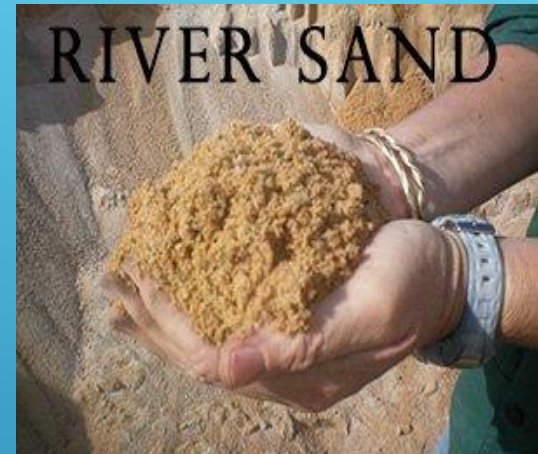
Source: It is obtained from river bed or river bank.

Grain: This sand consists of fine rounded grains and It is well graded.

Sand Type: River sand is a fine type sand.

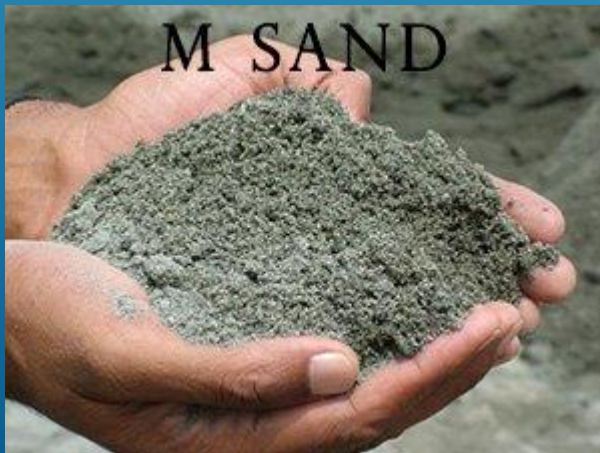
Color: It has white-grey color.

Uses: It is available in clean condition and can be widely used for all-purpose of construction activities like plastering and concreting.



CRUSHED STONE SAND/ ARTIFICIAL SAND/ M SAND

It is a substitute for River Sand, it is also known as fine aggregates which is manufactured by crushing either granite or basalt rock using 3 stage crushing process by some companies. This sand is manufactured in conformance to IS Codes and is an effective alternative to river sand also known popularly as M Sand.



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TYPES OF SAND BASED ON THEIR GRAIN SIZE

Based on the grain size of the sand it can be classified as following:

Very Fine Sand

If the grain size of the sand between 0.0625 mm to 0.125 mm then it is called very fine sand.

Fine Sand

The grain size of this type of sand is between 0.125mm to 0.25mm

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TYPES OF SAND BASED ON THEIR GRAIN SIZE

Medium Sand

If the grain size of the sand between 0.25mm to 0.50mm.

Coarse Sand

This type of sand's grain size is between 0.50mm to 1.0mm

Very Coarse Sand

The grain size of this type of sand is between 1.0 mm to 2.0 mm.

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Types of Sand Based on Their Grain Size

ϕ scale	Size range (metric)	Size range (approx. inches)	Aggregate name (Wentworth class)	Other names
<-8	>256 mm	>10.1 in	Boulder	
-6 to -8	64-256 mm	2.5-10.1 in	Cobble	
-5 to -6	32-64 mm	1.26-2.5 in	Very coarse gravel	Pebble
-4 to -5	16-32 mm	0.63-1.26 in	Coarse gravel	Pebble
-3 to -4	8-16 mm	0.31-0.63 in	Medium gravel	Pebble
-2 to -3	4-8 mm	0.157-0.31 in	Fine gravel	Pebble
-1 to -2	2-4 mm	0.079-0.157 in	Very fine gravel	Granule
0 to -1	1-2 mm	0.039-0.079 in	Very coarse sand	
1 to 0	0.5-1 mm	0.020-0.039 in	Coarse sand	
2 to 1	0.25-0.5 mm	0.010-0.020 in	Medium sand	
3 to 2	125-250 μm	0.0049-0.010 in	Fine sand	
4 to 3	62.5-125 μm	0.0025-0.0049 in	Very fine sand	
8 to 4	3.9-62.5 μm	0.00015-0.0025 in	Silt	Mud
10 to 8	0.98-3.9 μm	3.8×10^{-5} -0.00015 in	Clay	Mud
20 to 10	0.95-977 nm	3.8×10^{-8} - 3.8×10^{-5} in	Colloid	Mud

Types of Sand Based on Their Grain Size

ISO 14688-1:2002

Name			Size range (mm)	Size range (approx. in)	
Very coarse soil	Large boulder	LBo	>630	>24.8031	
	Boulder	Bo	200–630	7.8740–24.803	
	Cobble	Co	63–200	2.4803–7.8740	
Coarse soil	Gravel	Coarse gravel	CGr	20–63	0.78740–2.4803
		Medium gravel	MGr	6.3–20	0.24803–0.78740
		Fine gravel	FGr	2.0–6.3	0.078740–0.24803
	Sand	Coarse sand	CSa	0.63–2.0	0.024803–0.078740
		Medium sand	MSa	0.2–0.63	0.0078740–0.024803
		Fine sand	FSa	0.063–0.2	0.0024803–0.0078740
Fine soil	Silt	Coarse silt	CSi	0.02–0.063	0.00078740–0.0024803
		Medium silt	MSi	0.0063–0.02	0.00024803–0.00078740
		Fine silt	FSi	0.002–0.0063	0.000078740–0.00024803
	Clay	Cl	≤0.002	≤0.000078740	

TYPES OF SAND BASED ON THEIR PURPOSE OF USE

Brick Sand

This sand is obviously used for brick work. The finest modulus of this sand should be 1.2 to 1.5 and should not contain more than 4% silt.

Plaster Sand

Obviously it is used for plastering work. The finest modulus should not be more than 1.5 and silt content should not be more than 4% in this type of sand.

Concrete Sand

For concreting purpose we generally use coarse sand. The finest modulus of this sand should be 2.5 to 3.5 and it should not contain more than 4% silt

Dr. Eng. Hassan Mohamed

THANKS

Please visit the following links:

<https://sites.google.com/site/scdgndeti/aggregate>

<http://www.eng2all.net/forum/engineering30373/>

<http://www.startimes.com/?t=16093023>

<https://www.youtube.com/watch?v=zRR0UHEJEjQ>

<https://www.youtube.com/watch?v=ui97zTT7rCU>

<https://www.youtube.com/watch?v=i4r5UjQBKS4>

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Dr. Eng. Hassan Mohamed